DOCUMENT RESUME

ED 177 006 SE 029 121

TITLE Report of the District Review Committee of School District 39, Vancouver on the Assessment in Science, Spring 1978.

INSTITUTION Vancouver Board of School Trustees (British Columbia). Dept. of Evaluation and Research.

PUB DATE Feb 79

NOTE 73p.

EDRS PRICE MF01/PC03 Plus Postage.

DESCRIPTORS Educational Research; *Elementary School Science; Elementary Secondary Education; *Evaluation Methods; *Science Curriculum; Science Education; Science Instruction; Science Programs; *Science Teachers; *Secondary School Science

ABSTRACT

The results of an assessment of science performance of students enrolled in grades 4, 8 and 12 in Vancouver, British Columbia, in 1978 are reported. Separate panels interpreted the results for each grade level, and, based on these interpretations, four general recommendations were proposed to improve science education. In addition to a summary of the assessment activities, the document also includes five appendices. Three of these are the separate reports for each grade level tested. Also included are a secondary curriculum reference chart and a list of teachers' priorities for change. (PB)

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REPORT OF THE DISTRICT REVIEW COMMITTEE OF SCHOOL DISTRICT 39, VANCOUVER ON THE ASSESSMENT IN SCIENCE SPRING, 1978

FEBRUARY, 1979

SE 029 121

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SUMMARY

Three interpretation panels of administrators and teachers assessed the Science performance of Vancouver students in Grades 4, 8 and 12. The interpretation panel reports in Appendices A, B and C were examined by the District Review Committee which consisted of a trustee, professional association representatives, panel members, officials, students and parents. Separate sets of recommendations were made by the District Review Committee for each assessment in Grades 4, 8 and 12. Although each recommendation stands on its own merit, there were some common elements such as the "hands on" approach, shift to interpretive discussions and activities, safety and time allotments which are outlined below.

a. More emphasis on the "hands on" approach in elementary science

This approach which involves the manipulation and use of scientific materials encourages the integration of language development in science, increases motivation, promotes creativity and utilizes the higher levels of intellectual thought (i.e. application, analysis, synthesis and evaluation).

b. Increased emphasis on interpretive discussions and activities in secondary science

At the secondary school level teachers should ensure that there is not an overemphasis on laboratory activities that require following instructions to the detriment of interpretive discussion.

The Ministry of Education should provide new curricula and instructional materials so that secondary teachers could more successfully promote the development of skills such as designing experiments and interpreting data, the ability to discuss intelligently the current issues related to science, and an appreciation of the nature and methods of science.

c. Safety

Students need instructions and demonstrations on the handling of equipment, materials and other hazardous products which students are likely to encounter both in and out of school.

d. Sufficient time for science

School staffs should ensure that sufficient time is being allotted for science education. The minimum time requirements suggested in the draft Administrative Handbook for Elementary and Secondary Schools* are:

Grade	1	2	3	4	5	6	7	8	9	10
Minutes/ Week	40	40	60	80	80	100	100	Total: 360 hours during three years		

based on 1500 minutes/week of assigned time

However, the District Review Committee recommends additional minimum time requirements for Grades 5, 6 and 7 as follows:

- 100 minutes/week for Grade 5
- 120 minutes/week for Grade 6
- 120 minutes/week for Grade 7

In addition all three reports recommend that students, teachers and parents in School District #39 be made aware of the performance of Vancouver students on all recent learning assessments conducted by the Ministry of Education.

*Administrative Handbook for Elementary and Secondary Schools (Ministry of Education) - Draft, January, 1979, pp. 57 and 60.

LEARNING ASSESSMENTS IN BRITISH COLUMBIA

Purposes and Rationale

The Learning Assessment Branch of the B.C. Ministry of Education, beginning in 1974, has developed plans to conduct periodically a review of student performance and instructional practices in a number of curriculum areas. The purposes of these assessments are:

a) to monitor student learning,

b) to inform the public of the strengths and weaknesses of the public school system,

c) to provide the province and individual districts with information which can be used to maintain strengths and overcome identified weaknesses,

d) to assist curriculum developers at the provincial and local levels in the process of improving curriculum and developing suitable resource materials,

e) to provide directions for change in teacher education and professional development,

f) to provide information that can be used in the allocation of resources at provincial and district levels, and

g) to provide directions for educational research.

The program is not concerned with the assessment of specific courses such as Physics 12 or Science 9, but is designed to cover a broad range of subject matter with a stress on those skills that are needed to function effectively in society.

Procedures

The assessment program in each curriculum area starts with an effort to identify the instructional goals and to derive from those goals the learning outcomes or objectives which form the basis of the assessment of student performance. The statement of instructional goals also forms the basis for collecting information from teachers and school administrators regarding instructional practices in the curriculum area assessed.

The second step is the development and piloting of the instruments needed to collect the data of interest. Typical instruments are:

a) a test, used to measure student performance, along with a questionnaire asking for information descriptive of the student,

b) a teacher questionnaire eliciting information about instructional practices, and

c) a student questionnaire for measuring attitudes and perceptions.

This step involves the trying out of items and the review of the materials by various panels of teachers, teacher educators and members of the lay public at a number of centres.

Next, the data are collected in a province-wide administration of the test to students and the questionnaire to public school teachers. In most cases the entire provincial population of a specific grade is the target of this data collection.

Finally, the data are summarized and interpreted. Two questions are of prime importance: What have our students learned? (Can they cope with the real world?) and, How do they compare with students four or eight years ago? (Are we holding our standards?). This emphasis on the total program calls for different and somewhat new procedures in the evaluation of the test results.

Outcomes

The outcomes of the assessment of a specific curriculum area are of both a tangible and an intangible nature. Most concretely, there are a number of reports detailing the test and questionnaire results. Those reports deal with the data at the provincial as well as at the district level. More subtly, the outcomes of the assessments increase the professional awareness of student abilities and professional practices.

A continuous and systematic program of assessment can produce longitudinal information to answer the important and deceptively simple questions:

How well are the educational programs in our schools meeting the needs of our children?

Are we meeting the purposes or goals of our instructional programs for all children as these purposes change?

BRITISH COLUMBIA SCIENCE ASSESSMENT

The 1978 British Columbia Science Assessment is part of the on-going provincial learning assessment program. This program is designed to indicate strengths and weaknesses within the public school system, to generate information for decision-making, and to provide direction for curriculum development and educational research.

After a year of planning, development, and review, the Science Assessment was conducted in the Spring of 1978 when:

- more than 100,000 students in Grades 4, 8, and 12 of the public school system were tested for achievement in science during the week of 1978-03-13 to 1978-03-17,
- more than 3500 teachers completed mail-in questionnaires concerning their science teaching practices and other factors affecting the learning of science in their classrooms, and
- almost 9000 students in Grades 7, 9, and 11 of the public school system completed questionnaires designed to measure their attitudes towards science and scientists, and to determine their perceptions of the teaching practices in their science classes.

The student tests were designed to measure a number of aspects of science achievement at each of three levels: the end of primary education (Grade 3), the end of elementary education (Grade 7), and the end of public schooling (Grade 12).

The tests were given to students enrolled in Grades 4, 8 and 12 regardless of whether they were taking science courses. The questions were designed to assess the kinds of understanding and skill which should develop over time in any good science program, rather than the specific knowledge which might be part of one particular science course. For example, the science content of the Grade 12 test did not go beyond that of the present science curriculum at the Grade 10 level.

The tests and questionnaires were developed and the results analyzed by a group of university science educators and school science teachers under contract to the Ministry of Education. This contract team received advice and assistance from a management committee consisting of Ministry of Education officials, teachers, a school trustee, and a university professor. Distribution and collection of the tests and questionnaires, scoring, and processing of data, were carried out by the B.C. Research Council.

The test results were interpreted by panels, constituted by the Ministry of Education, whose task was to examine the results and judge their degree of acceptability. Before seeing any test results, the panels consisting of educators, school trustees, and other members of the general public considered the test questions that were used to measure each objective and then determined the range of performance that they would find acceptable for the objective.[1]

When each panel had reached consensus agreement on all of the objectives in a particular domain, the actual student results were distributed and a comparison between the defined range of acceptable performance and actual student results was made. Where actual performance was lower than the acceptable range, it was viewed as a weakness that would benefit from further investigation and corrective action. Where the actual performance was higher than that predicted by the panel, it was viewed as a strength. Where actual performance fell within the panel's predicted range, it was viewed as satisfactory or acceptable.

The test performance of students in Grades 4, 8 and 12 was reported on the following bases:

a) individual school districts (i.e. Vancouver),

b) regional areas (i.e. Metro or Lower Mainland), and the

c) province of British Columbia.

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1. It is important to note several limitations of the use of this process. Most important among these are the subjective nature of the opinions, the lack of representativeness of the group, and the illusion of precision created by assigning numerical values to the ranges of acceptable performance. The comparison between actual results and these intervals must be viewed with caution, since another group might interpret the data differently.

The questionnaire responses of science teachers and of the student sample from Grades 7, 9 and 11 are summarized only at the provincial level.

These findings of the Science Assessment are published* in the General and Summary Reports. For the major findings of the assessment the reader is directed to the Summary Report, pages 8 and 9.

THE REVIEW PROCESS IN SCHOOL DISTRICT 39 (VANCOUVER) (1978-01-06 TO 1979-02-07)

The guidelines used by the Ministry of Education panels for interpreting student performance on a provincial basis were employed for assessing the test results of Grades 4, 8 and 12 students in Vancouver public schools.

ACTIVITIES OF THE INTERPRETATION PANELS

Applications to serve on the Interpretation Panels were sought from qualified staff members. After the Ministry's guidelines were reviewed at a meeting on 1978-11-06, the following panels were established for the science assessments in Grades 4, 8 and 12. After the initial meeting, the panel groups met separately on various occasions to develop their reports which appear in Appendices A, B and C.

INTERPRETATION PANEL FOR SCIENCE, GRADE 4

David Brear - Lord Roberts Elementary School
Allan Hare - Sir Richard McBride Elementary School (Chairman)
Ron Leversage - Principal, Britannia Elementary School
Mark Proctor - Tecumseh Elementary School Annex
Bob Stevens - Evaluation and Research Services
John Zappavigna - Shaughnessy Elementary School

INTERPRETATION PANEL FOR SCIENCE, GRADE 8

Larry Levchuk - Killarney Secondary School
Doug McLeod - John Oliver Secondary School
Allan Moodie - Evaluation and Research Services (Chairman)
Hart Scarrow - Science Department Head, Killarney Secondary School
Russ Selwood - Lord Byng Secondary School
Min Sugimoto - Principal, Killarney Secondary School
John Uzelac - Curriculum and Professional Development Services

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*Copies of all of these reports are available upon request from the Learning Assessment Branch, Ministry of Education.

INTERPRETATION PANEL FOR SCIENCE, GRADE 12

John Allan - Assistant Superintendent, East Area
Cary Chien - David Thompson Secondary School
Norm Ellis - Head of Evaluation and Research Services
Richard Hopkins - King George Secondary School
Bill Jacobsen - Vice-Principal II, Vancouver Technical Secondary School
Bruce Wood - David Thompson Secondary School (Chairman)
John Worobec - Science Department Head, Magee Secondary School

The nature of their task required that panel members have a high degree of familiarity with the subject area, have contact with the students in the age/grade range, and have an understanding of local educational aspirations as well as the background of student characteristics. The interpretation panels were to complete the first phase of the review process, i.e.

- to review the objectives being assessed, the test items and background data of the students,
- to reach consensus in setting "acceptable" and "desired" levels of performance for each item of each objective assessed and for each group of related objectives (or "goal"),
- to compare district results with the panel's pre-established expectations and rate the performance on a five-point scale of satisfaction,
- to identify strengths and possible weaknesses in achievement and to consider the implications for instruction, and
- to summarize the findings and present observations that would facilitate the second phase of the process that was to be completed by the District Review Committee.

ACTIVITIES OF THE DISTRICT REVIEW COMMITTEE

The findings of the interpretation panels were then presented to the District Review Committee which included a trustee, representatives from each of the professional associations, two representatives from each panel, officials, three student representatives, and five parents, one from each area. The members were:

John Allan, East Area Assistant Superintendent
Gordon Calderwood, VSAA (Tyee)
A. Currie, East Area Parent Representative
Nathan Divinsky, Trustee (replaced by Karl Erdman, Trustee)
Barbie Edluayen, Magee Student Representative
Norm Ellis, V.S.B. (retired 79-01-31)
David Gurd, South Area Parent Representative
Allan Hare, Grade 4 Interpretation Panel (McBride)
Jack Leake, VSTA (Kitsilano)
Doug McLeod, Grade 8 Interpretation Panel (John Oliver)
Douglas Mitchell, North Area Parent Representative
Allan Moodie, V.S.B.
Sheri Oishi, Centre Area Parent Representative
Sang Park, Vancouver Technical Student Representative
Al Paterson, VESTA (Britannia Elementary)
Bob Peacock, VSCA (V.S.B.)
David Perrin, VSTA (Hamber)

Russ Selwood, Grade 8 Interpretation Panel (Byng)
Bob Stevens, V.S.B.
Daryl Sturdy, VESTA (Carnarvon)
John Uzelac, Chairman, V.S.B.
Laszlo Veto, West Area Parent Representative
Bud Winteringham, VSAA (Tupper)
Gane Wong, U.B.C. Student Representative
Bruce Wood, Grade 12 Interpretation Panel (Thompson)
John Worobec, Grade 12 Interpretation Panel (Magee)
John Zappavigna, Grade 4 Interpretation Panel (Shaughnessy)

Members of the District Review Committee attended six meetings to present and discuss their conclusions and observations. Meetings of the committee were held on:

1978-12-14	1979-01-24
1979-01-08	1979-01-31
1979-01-17	1979-02-07

(Copies of the summaries of these meetings are on file in the office of Evaluation and Research Services, Vancouver School Board.)

The District Review Committee's responsibility was to consider the panels' findings and to translate them into educationally relevant recommendations; i.e., recommendations that would serve to promote the maintenance of strengths and to induce positive change in areas that fall short of district expectations. These recommendations appear in the reports which follow.

CONCLUSIONS, RECOMMENDATIONS AND OBSERVATIONS IN REGARD TO SCIENCE ASSESSMENTS

REPORT ON THE GRADE/YEAR 4 SCIENCE ASSESSMENT

General Conclusions

Vancouver students performed at approximately the same level on the Grade/Year 4 science assessment test as did students in Zone 2 (Metro) and/or students throughout the province in general. Despite the reading difficulties of many Vancouver students and despite the inadequacies of the test, the committee was prompted to conclude that the performance of the students of School District #39 was satisfactory.

One of the purposes of the science assessment was to inform the public of the strengths and weaknesses of the public school system. Consideration should be given how best this end could be achieved, possibly through a press release to the public.

Recommendations

1. That the students, teachers and parents of School District #39 be made aware of the performance of Vancouver students on all recent learning assessments conducted by the Ministry of Education.

2. That, in the instructional program for primary students, greater attention be directed to the mastery of the metric system.

3. That, through further support, professional development and the provision of additional materials, teachers stress the "hands on" approach in science. The "hands on" approach involves the manipulation and use of science materials. This approach encourages the integration of science with other subject areas, promotes creativity and increases motivation.

4. That the safe handling of all potentially dangerous material be stressed by all teachers as a necessary life skill, e.g., the handling of science equipment, materials and hazardous products which students are likely to encounter both in and out of school. It is further recommended that audio-visual materials be made available to schools and teachers to stress the warnings contained in the Federal Government's hazardous materials program on toxicity, flammability, corrosiveness and explosiveness.

5. That primary students receive more experience in

   a) using balances,
   b) interpreting line graphs,
   c) measuring, and
   d) conducting experiments.

REPORT ON THE GRADE 8 SCIENCE ASSESSMENT

General Conclusions

Grade 8 students in Vancouver schools performed at approximately the same level on the science assessment test as did students in Zone 2 (Metro) and throughout the province in general. Student performance for the objectives of Goal 1: Concepts and Knowledge and Goal 2: Processes was generally satisfactory whereas more attention was suggested for the last three goals on Applications, Safety and Scientific Literacy.

Recommendations

1. That the students, teachers and parents of School District #39 be made aware of the performance of Vancouver students on all recent learning assessments conducted by the Ministry of Education.

2. At the elementary school level more "hands on" activities designed to utilize the higher levels of intellectual thought (i.e. application, analysis, synthesis and evaluation) would assist in improving student performance in Goal 3: Applications.

3. Elementary school staffs should ensure that sufficient time is being allotted for science education. The minimum time requirements suggested

3. in the draft Administrative Handbook for Elementary and Secondary Schools** are:

Grade	1	2	3	4	5	6	7
Minutes/ Week	40	40	60	80	80	100	100

However, the District Review Committee recommends additional minimum time requirements for Grades 5, 6 and 7 as follows:

- 100 minutes/week for Grade 5
- 120 minutes/week for Grade 6
- 120 minutes/week for Grade 7

4. Students need instructions and demonstrations on laboratory safety which should be introduced early in each science course. Booklets on safety such as the Laboratory Science Safety Guide*** and the Fisher Manual of Laboratory Safety****, should be distributed to all teachers of science.

5. At the secondary school level teachers should ensure that there is not an overemphasis on laboratory activities that require following instructions to the detriment of interpretive discussion which is needed to improve performance on Goal 5: Scientific Literacy. Oral discussion of scientific concepts and applications is as important as the laboratory work which illustrates these principles.

REPORT ON THE GRADE 12 SCIENCE ASSESSMENT

General Conclusions

The performance of Grade 12 students in Vancouver schools was rated satisfactory or better on 57.5 percent of the items in the science assessment test. However, the panel considered the overall test results of Vancouver students in Grade 12 to be slightly less than satisfactory.

Recommendations

1. That the students, teachers and parents of School District #39 be made aware of the performance of Vancouver students on all recent learning assessments conducted by the Ministry of Education.

** Administrative Handbook for Elementary and Secondary Schools (Ministry of Education) - Draft, January, 1979, p. 57.

*** Laboratory Science Safety Guide (Prepared and produced jointly by the British Columbia Teachers' Federation and the Department of Education), Victoria, B.C., 1975, p. 10. (Currently under revision).

**** Fisher Manual of Laboratory Safety Bulletin No. 202 (Can.) Pittsburgh, Pa: Fisher Scientific Company, 1972. p. 60.

2. The district review committee suggests that the present curriculum places too great an emphasis on the process of science and the committee recommends that a greater emphasis be placed on practical applications of experimental discoveries and on the acquisition of scientific knowledge which would include supplemental reading.

3. The committee urges that junior secondary science teachers continue their attempts to have students approach a mastery level of understanding the basic concepts of science. Schools should ensure that enough time is provided so that at the end of Science 10, students shall have been taught the core areas of Biology, Chemistry, Physics and Earth/Space Science.

4. In regard to the first recommendation of the contract team (see Summary Report, page 44), the committee endorses the suggestion that a curriculum revision committee revise the junior secondary program. This revision should articulate with the Kindergarten - Grade 7 program. The committee further suggests that the shift be away from a primary focus on "process".

5. The committee endorses recommendation 4 (see Summary Report, page 45) that teachers widen their repertoire of methods of teaching science at the junior secondary level and that they allocate some of the time spent on routine marking of laboratory reports to the planning of different approaches.

6. The committee supports recommendation 18 (see Summary Report, page 47) "That teachers of science at both the junior and senior secondary levels make a conscious effort to promote the development of skills such as designing experiments and interpreting data, the ability to discuss intelligently the current issues related to science, and an appreciation of the nature and methods of science."

7. The committee recommends that the school district investigate the sizes of their junior secondary science classes and consider reducing large classes to levels compatible with safety as advocated in the Laboratory Science Safety Guide.*****

8. The committee recommends that science class size be included in a staff ratio formula which would limit secondary science classes to 24 students.

9. Similarly, a modification in recommendation 8 (see Summary Report, pages 45 - 46) that school districts designate selected personnel to be secondary science consultants.

10. The majority of the district review committee endorses recommendation 16 (see Summary Report, page 47). The committee recommends:

    a) wide dissemination of information and curriculum resources used in presently existing courses (locally-developed or otherwise) such as Technology 11, Earth Science 11, Human Biology 11, Agriculture 11, Horticulture 11. This information transfer should reduce duplication of effort in providing local alternatives.

*****Laboratory Science Safety Guide, loc. cit.

10. b) more opportunities be provided for students to take science courses suited to a variety of maturity and ability levels.

A minority committee report is presented as item 7 of the Grade 12 Interpretation Panel report (see Appendix C).

11. In regard to recommendation 17 (see Summary Report, page 47), the committee suggests instead that school districts should ensure that the time allotments recommended in the Administrators' Handbook (see Reference Chart in Appendix D) be followed in secondary science courses.

Grade	8	9	10
Time	Total: 360 hours during three years		

12. The data sought in provincial assessments should include information about each student's English language background.

13. The committee supports recommendation 2 (see Summary Report, page 44) "that the Ministry of Education, as a priority item, increase the selection of texts and supplementary reading materials available to teachers of the present junior secondary science curriculum as long as it is in force".

ADDITIONAL RECOMMENDATIONS

In addition to reviewing the recommendations of the Grades 4, 8 and 12 Interpretation Panels, the District Review Committee considered a number of recommendations that arose from individual members. The following were approved by the District Review Committee for inclusion in the report:

1. At the elementary school level, the purposes of science activities should be carefully outlined and students should be encouraged to keep careful records of the processes, apparatus, materials and data gathered, in order to draw conclusions. "What is important in a laboratory report is that the student state the purpose of the exercise, record his observations and form a conclusion. Undue emphasis on neatness and artistic work (such as the recopying the record made during the exercise) should be discouraged."******

2. That there be at least one Elementary Consultant with a strong science background and that the consultant's focus of work be in science.

3. That the school district investigate the adequacy of physical facilities in elementary science rooms, particularly with regard to sinks, storage space, and suitable work surface for students.

****** Science 8 Secondary Guide (Curriculum Development Branch, Ministry of Education), p. 5.

4. The committee supports recommendation 5 (see Summary Report page 47) "That the Ministry of Education establish a committee to make a special study of the social and educational implications of the preponderance of males who are studying and teaching science in the secondary schools. The committee should conduct and sponsor research to determine if there are any factors within the school system which contribute to this situation, and which can be corrected. Further, they should suggest ways in which teachers can counteract factors operating outside the school system."

5. That teachers without a science background who are required to teach science should be provided with an appropriate in-service program.

6. The committee draws trustees' attention to a number of suggested changes (see Summary Report, page 42 or Appendix E) that would improve the quality of science instruction and learning in classrooms.

7. The committee recommends that a school's time allotments for secondary science courses be made available upon request to the public.

8. That the District Review Committee be reconvened in one year's time to study the effects/disposition of its recommendations.

ADDENDUM

At the final meeting of the District Review Committee on 1979-02-07, a representative of the Vancouver Elementary School Teachers' Association presented two further recommendations that the committee deemed outside its jurisdiction. However, the representative requested that the trustees be made aware of the following recommendations:

1. That teachers in elementary schools should have at least one period per week of preparation time.

2. That in order to ensure the best learning and working conditions for students, class sizes in the elementary school should not exceed 20 in Kindergarten, 25 in Primary Grades 1-3 and 30 in Intermediate Grades 4-7.

APPENDIX A

REPORT OF THE INTERPRETATION PANEL

SCIENCE, GRADE/YEAR 4 LEARNING ASSESSMENT

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REPORT OF THE INTERPRETATION PANEL

SCIENCE, GRADE/YEAR 4 LEARNING ASSESSMENT

DECEMBER 5, 1978

GENERAL CONCLUSIONS

Vancouver students performed at approximately the same level on the Grade/Year 4 science assessment test as did students in Zone 2 (metro) and/or students throughout the province in general. Despite the reading difficulties of many Vancouver students and despite the inadequacies of the test, the interpretation panel was prompted to conclude that the performance of the students of School District 39 on the test was satisfactory.

One of the purposes of the science assessment was to inform the public of the strengths and weaknesses of the public school system. In the opinion of the interpretation panel, this has not been done. Consequently, the District Review Committee might consider how best this end could be achieved.

RECOMMENDATIONS

1. That the students, teachers and parents of School District #39 be made more aware of the performance of Vancouver students on all recent learning assessments conducted by the Ministry of Education.

2. That, in the instructional program for primary students, greater attention be directed to the mastery of the metric system.

3. That, through further support, professional development and the provision of additional materials, teachers stress the "Hands On" approach in science.

4. That the excitement of the "Hands On" approach be utilized to encourage further the development of language skills of students, i.e., oral skills, writing, reading and listening.

5. That the safe handling of all potentially dangerous material be stressed by all primary teachers, e.g., the handling of science equipment and materials and other hazardous products which students are likely to encounter.

6. To support Recommendation 5, it is recommended that audio-visual materials be made available to schools and teachers to stress the warnings contained in the Federal Government's hazardous materials program on toxicity, flammability, corrosiveness and explosiveness.

7. That primary students receive more experience in

   (a) classifying abstract items,
   (b) using balances,
   (c) interpreting line graphs,
   (d) measuring, and
   (e) experimenting.

BACKGROUND INFORMATION

The Grade/Year 4 science assessment test contained 68 items designed to assess student performance with respect to five goals of the primary grade

science curriculum. The science contract team grouped the goals and objectives within them as follows:

GOALS AND OBJECTIVES FOR GRADE/YEAR 4

Goals	Objectives	Number of Items
1. Concepts and Knowledge		26
2. Processes	2.1 Classifying	5
	2.2 Observing	5
	2.3 Communication	6
	2.4 Measuring	7
	2.5 Combined skills[1]	5
3. Applications		5
4. Safety		5
5. Scientific Literacy		4

The Science Contract Team placed approximately equal emphasis on the "Concepts and Knowledge" goal and on the "Processes" goal. The other three goals were represented by considerably fewer items.

The Processes goal, which contained 28 items, was divided into five objectives. The objectives, "Classifying", "Observing" and "Combined skills", were allotted five test items each whereas "Communications" was represented by six items and "Measuring" by seven items.

In addition to the science items, the test contained five personal background information items which students were asked to complete before beginning the test itself.

The science assessment test was written by 3,989 Vancouver students (95.8% of the number enrolled in Grade/Year 4 of the Vancouver schools). Ninety-five point five percent of the students were nine or ten years of age. Fifty point eight percent were males and 48.8% were females.

Because the Reading Assessment (Grade/Year 4)--Language B.C. (Project 1976) obtained more background information than did the 1978 Science Assessment, some background statistical information from the Reading Assessment will be included for reference purposes in this present report (see Appendix A).

The Grade/Year 4 science test was divided into two parts. Forty-five minutes were allotted for the distribution and completion of each part. Teachers administering the test were asked to read aloud the stem of each test question in order to minimize the potentially confounding effects of students' difficulties in reading.

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[1] Combined skills: designing experiments, controlling variables, interpreting data.

In reviewing the test, the interpretation panel considered that the test measured--in so far as a paper-and-pencil test is capable of measuring--the students' understanding of basic or essential skills and concepts presented in the science curriculum of the primary years.

ANALYSIS OF THE TEST

1. General Comments

The Science Contract Team, it was felt, made a sincere effort to focus on "Processes". For this effort, they should be commended. In addition, the layout was clear and uncluttered with respect to many diagrams, drawings and/or sketches. The time allotment for the test was generous and other procedures, such as the reading of the stem of the questions, served to reduce tension at the time of testing.

2. Criticism of the Test

The interpretation panel had six areas of concern and these are briefly discussed below. For criticism of specific items or aspects of the test, see the appropriate Appendices A to G.

(i) Several test items were included which do not reflect what is in the Kindergarten to Grade/Year 4 science curriculum, e.g., items 2, 7 and 35. Were these items included to test a concept or one's general knowledge? (See Appendix B for further detail)

(ii) Some of the test items required an inappropriately high level of reading ability and/or other skills, e.g., items 10 and 58. For example, item 10 not only demands high reading ability but also requires mental manipulation of symbols and an understanding of difficult abstract concepts. Therefore, in responding to the item, reading could be a more significant factor than ability in science. (See Appendix C)

(iii) The art work contained in some of the items was not clear in depicting the questions to be answered, e.g., items 1, 12, 49, 54, 59, 62 and 65. (See Appendix D.)

(iv) In the question requiring measurement, an atypical ruler with no "0" was introduced. (See Appendix E)

(v) There are some test items which, in the opinion of the interpretation panel, have several plausible answers which are, in themselves, true, e.g., items 5, 19 and 42. Students would have great difficulty in deciding which is the "best" response. (See Appendix F)

(vi) The panel, in its deliberations, found the background information provided to be inadequate, e.g., information was obtained on the sex of students but a breakdown of responses by sex was not presented.

CURRICULUM IMPLICATIONS

1. Metric system

One of the specific recommendations of the District Review Committee of School District #39 on the assessment in mathematics (Grade/Year 4) February 15, 1978 was:

> "That in the instructional program of primary mathematics greater attention be directed to the mastery of the metric system."[2] (page (i))

In the 1978 science assessment, there were six questions which involved knowledge of the metric system. Table 1 indicates the percentages of students responding correctly in District #39, the zone and in the province.

TABLE 1: SUMMARY OF ITEMS INVOLVING METRICS
SHOWING PERCENTAGES OF STUDENTS SELECTING CORRECT RESPONSES

Item Number	District #39	Province	Zone
3	69	71	71
8	65	56	62
25	79	78	79
33	78	82	82
44	68	65	66

Based on the percentage of students who selected the correct response, this interpretation panel felt that the specific recommendation of the Mathematics District Review Committee should be stressed again. A percentage higher than 65 - 79% of the students selecting correct responses is desired.

2. "Hands On Approach"

In the introduction of "The Elementary Science (Interim) 1977 Curriculum Guide", the Curriculum Development Branch stresses that this program "is a materials based program which necessitates the involvement of students in scientific activities and explorations" or involves a "Hands on approach" with definite objectives and follow-up activities.

If this approach had been widely used in the science K-4 program, would not the students tend to do well in answering those test items which might best be learned via this technique?

Table 2 indicates the percentages of students who responded correctly to test items which seem to measure a "hands on" approach to science.

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[2] Report of the District Review Committee of School District #39, Vancouver on the Assessments in Reading (Grades 8 and 12) and Mathematics (Grades 4, 8 and 12), March, 1977. Released on February 15, 1978.

TABLE 2: PERCENTAGES OF STUDENTS RESPONDING TO SPECIFIC ("HANDS ON") TEST ITEMS

Goal/Objective	Test Item	District #39	Province	Zone
1	A01	88	90	89
1	A05	32	35	34
5	A10	46	45	47
1	A15	48	51	50
2.5	A17	86	91	90
1	A19	22	21	21
2.5	A32	57	62	61
3	A35	46	47	48
1	A36	71	73	73
1	B42	54	52	53
1	B47	64	63	64
1	B48	68	79	77
1	B49	19	18	18
2.5	B52	64	66	65
1	B54	47	44	45
2.3	B55	61	59	59
2.5	B58	64	67	67
2.4	B59	38	40	40
3	B62	21	20	20

The interpretation panel feels that a "hands on approach" is not being used in all elementary schools in Vancouver. Table 2 may provide some support for this feeling in that the percentages of correct responses vary greatly and that students might be expected to perform at a consistently higher level if the use of this approach were more uniform across the city.

3. Reading

Reading the March 1, 1977 Report of the District Review Committee of School District 39 (Vancouver) on the Reading Assessment (Grade/Year 4)--Language B.C.[3], one might expect the Vancouver students to score lower than others in the province on many of the test items on the science assessment test. However, an examination of the test results showed no marked differences between the performance of Vancouver students and others in B.C.

RATING OF STUDENT PERFORMANCE

1. Introduction

As suggested in the "Guidelines for Interpretation - District Assessment Results, 1978", each member of the interpretation panel followed the procedure of assigning "acceptable" and "desired" performance levels for every item on the test. The members' performance levels were then averaged for each item. Actual performance was then examined and compared with "acceptable" and "desired" levels to arrive at a group consensus as to

[3] For specific comments of this report, see Appendix G.

whether student performance on each item warranted which of the following:

5 = Strength
4 = Very Satisfactory
3 = Satisfactory
2 = Marginal Performance
1 = Weakness - Poor Performance

The panel kept in mind the following advice from the "Guidelines for Interpretation" booklet when assigning the 1 to 5 ratings:

> "The criteria of satisfaction will be unique to you as an individual and will be in terms of what you 'feel' student performance on this type of item should be. Keep in mind the following factors:
>
> - The total population of students in the district at this age/grade level.
> - The wide range of individual differences present within the grade level.
> - The difficulty of the item.
> - The level of performance of all students in the province and in your district zone grouping."

2. Interpretation of performance

As can be seen from Table 3, the interpretation panel rated performance as weak on 12 of the 68 test items, marginal on 13 items, satisfactory on 23 items, very satisfactory on 5 items and strong on 9 items.

The students showed particular strength in performance with regard to Objective 2.2, "Observing". The weak and marginal items were in the areas of understanding concepts, the process of "Measuring" and "Safety".

This low score in measuring is consistent with the information revealed by the earlier Mathematics Interpretation Panel with respect to weakness in the mastery of metrics.

In so far as the questions dealing with "Classifying" (Objective 2.1) are concerned, the percentage of students correctly answering the questions decreased as the students went from classifying familiar (or practical or known) objects to classifying unfamiliar ones.

Students also seemed to have some problem interpreting data shown in line graphs but not in bar graphs.

The interpretation panel found it difficult to assess accurately student performance with regard to Goal 3, "Application". The difficulty lay not with the manner in which students answered the test questions but with test questions 39 and 62. Panel members were unhappy with the choice of responses available for question 39. In so far as question 62 was concerned, not only was criticism levelled at the drawing but also with the use of the words "dropped" and "could bounce". Consequently, in their rating of students' performance, the results of the scoring on these two questions were disregarded and the panel members then concluded that student performance was satisfactory for this goal.

TABLE 3: SUMMARY OF RATINGS BY INTERPRETATION PANEL
OF PERFORMANCE ON SCIENCE ASSESSMENT TEST ITEMS
NUMBER OF ITEMS IN EACH RATING CATEGORY

	Strength	Very Satisfactory	Satisfactory	Marginal Performance	Weakness (Poor Performance)	Total
Goal 1						
Concepts and Knowledge	2	2	10	8	4	26
TOTAL	2	2	10	8	4	26
Goal 2 Processes						
Objective 2.1 (Classifying)	2		3			5
Objective 2.2 (Observing)	3	1	1			5
Objective 2.3 (Communicating)	1	1	3	1		6
Objective 2.4 (Measuring)			3	1	3	7
Objective 2.5 Combined Skills)	1	1	3			5
TOTAL	7	3	10	5	3	28
Goal 3 Applications	*	*	3	*	*	3+2
Goal 4 Safety					5	5
Goal 5 Scientific Literacy	**	**	**	**	**	4*
TOTAL TEST	9	5	23	13	12	68

* The interpretation panel felt that the results of Test Items 39 and 62 should be disregarded.

**Performance ratings not included in this report because "It was the opinion of the Contract Team who designed this test that this was not a meaningful goal at the Grade/Year 4 level" (page 9 - Guidelines for Interpretation District Assessment Results, 1978).

The actual percentages of Vancouver students scoring on Goal 4, "Safety", was, for every test item, below the acceptable and desired levels established by the interpretation panel. Much more emphasis should be placed on this area by all teachers. One way of achieving this would be to incorporate the warning and/or danger signs into the curriculum and to make them more available to teachers. At the present time, teachers must make or find their own.

The interpretation committee agreed with the statement of the Science Contract Team regarding Goal 5, "Scientific Literacy", that "this was not a meaningful goal at the grade 4 level".[4]

Table 4 presents the average "acceptable" and "desired" levels of the interpretation panel for each item of the test and compares these figures with the actual percentages of correct responses. Ratings on the 5-point scale (i.e., 1=Weakness to 5=Strength) are also provided.

---

[4]Summary Report - B.C. Science Assessment 1978, page 21.

TABLE 4: "ACCEPTABLE", "DESIRED" AND ACTUAL LEVELS OF PERFORMANCE AND RATINGS OF STRENGTHS, WEAKNESSES, ETC. FOR ALL TEST ITEMS

Goal / Objective	Item #	Acceptable Level (%)	Desired Level (%)	Actual % Correct	Rating 1=Weak to 5=Strong	Comments/Reasons
1	01	75	87	88	3	The interpretation committee
Concepts	02	74	84	75	3	were unhappy with some aspects
&	05	53	67	32	3	of the following questions:
Knowledge	07	43	58	31	2	01, 02, 05, 07, 19,
(Mean	08	76	89	65	1	42, 49 and 54.
61.1)	14	61	76	42	2	
	15	55	66	48	2	
	16	78	87	83	3	
	19	59	73	22	2	(See Appendices B-F for
	23	75	86	45	1	reasons.)
	24	78	88	84	3	
	26	50	68	42	3	
	30	70	82	86	5	
	34	71	83	94	3	
	36	67	79	71	3	
	38	64	77	50	2	
	41	65	80	63	2	
	42	58	75	54	2	
	47	55	72	64	3	
	48	58	73	68	3	
	49	32	51	19	1	
	50	63	79	95	5	
	51	69	79	83	4	
	54	46	62	47	2	
	63	63	77	53	1	
	68	74	87	87	4	

2 Processes						
2.1 Classifying (Mean = 79.2)	04	73	81	75	2	A problem when dealing with abstract items.
	06	83	90	95	5	
	40	74	82	74	2	
	45	76	87	92	5	
	61	62	73	61	2	
2.2 Observing (Mean = 91.1)	11	86	93	98	5	Very satisfactory performance.
	12	81	88	98	5	
	18	71	84	76	3	
	31	76	86	95	5	
	56	76	87	88	4	
2.3 Communicating (Mean = 70.4)	09	73	88	82	3	Students seemed to have some trouble interpreting a line graph.
	27	77	88	82	3	
	28	60	74	43	2	
	55	50	66	61	5	
	66	52	66	62	3	
	67	73	89	96	5	
2.4 Measuring (Mean = 67.6)	03	70	81	69	1	A lack of mastery of metrics.
	13	69	79	65	1	
	25	70	90	79	3	
	33	81	91	78	2	
	37	69	84	76	3	
	44	71	82	68	1	
	59	49	61	38	3	
2.5 Combined Skills (Mean = 70.0)	17	71	83	86	4	Satisfactory performance.
	29	64	77	78	5	
	32	56	72	57	3	
	52	54	70	64	3	
	58	61	75	64	3	

3	35	40	65	46	3	Interpretation Committee not
Appli-	39			19		happy with question 39 and 62.
cations	46	62	84	74	3	
(Mean =	62		21			
45.3)	65	52	80	65	3	
4	20	92	98	84	1	In view of "Hands-on"
Safety	21	92	98	86	1	experimentation, students'
(Mean =	22	91	98	78	1	performance rated a weakness.
77.3)	57	91	74	98	1	
	64	71	82	64	1	
5	10	35	63	46		The committee felt that this
Scientific	43	45	60	23		goal difficult to test at the
Literacy	53	50	64	44		grade/year 4 level.
	60	48	61	62		

SCIENCE GRADE 4 INTERPRETATION PANEL MEMBERS

David Brear - Lord Roberts Elementary

Allan Hare - Sir Richard McBride Elementary - Chairman

Ron Leversage - Britannia Elementary

Mark Proctor - Tecumseh Annex

Bob Stevens - Research Associate, Evaluation and Research Services

John Zappavigna - Shaughnessy Elementary

A P P E N D I C E S

Appendix A	Background Information on Grade/Year 4 Students Attending Vancouver School Board Schools in 1976.
Appendix B	Test items Which, in the Opinion of the Interpretation Committee, are Not Part of the K-4 Science Curriculum.
Appendix C	Items Which Require an Inappropriately High Reading Level.
Appendix D	Art Work Not Clear in Depicting Question.
Appendix E	Confusing Ruler.
Appendix F	Test Items Which Have Several Plausible Responses.
Appendix G	Selected Comments from the March 1, 1977 report of the District Review Committee of School District #39, Vancouver on Reading Assessment (Grade/Year 4) - Language, B.C.

APPENDIX A

Background Information on Grade/Year 4 Students Attending Vancouver School Board Schools in 1976.*

1. Number of schools attended since students started Grade 1.

		Province %	Vancouver %
School attended	1	44.1	50.7
	2	28.8	26.5
	3	14.4	13.1
	4 +	12.8	9.8

2. Percentage of students born in Canada.

		Province %	Vancouver %
Born in Canada	YES	87.1	72.4
	NO	12.9	27.6

3. Percentage of students who know how to speak a language other than English before beginning school.

		Province %	Vancouver %
Other Language	YES	22.2	45.4
	NO	77.8	54.6

4. Percentage of students for whom English is the only language spoken at home.

		Province %	Vancouver %
English only at home	YES	62.8	43.8
	NO	37.2	56.3

* Information taken from the Report of the District Review Committee of School District #39, Vancouver on the Reading Assessment (Grade/Year 4) - Language B.C., March 1, 1977, pages 16 and 17.

APPENDIX B

Test items which, in the opinion of the Interpretation Panel, are not part of the K-4 Science Curriculum

It is the considered opinion of the Interpretation Panel that concepts and/or knowledge required for the following test items do not form part of the K-4 science curriculum.

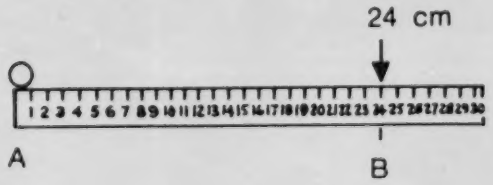
Did the Science Contract team include them to test general knowledge?

The numbers in brackets indicate the percentage of students who selected each response. "Correct" responses are marked with an "X".

2. Each year the Earth moves once around

(2)	Mars	☐ 1
(2)	Saturn	☐ 2
(75)	the Sun	☒ 3
(12)	the Moon	☐ 4
(4)	all of the other planets	☐ 5
(5)	I don't know	☐ 6

7. The picture below shows a marble and a ruler. If the marble rolls from A to B in 2 seconds at a steady speed, how fast is it going?



(23)	12 cm per 2 seconds	☐ 1
(26)	24 cm per second	☐ 2
(8)	24 mm per second	☐ 3
(2)	240 mL per second	☐ 4
(31)	12 cm per second	☒ 5
(9)	I don't know	☐ 6

Test item 7 is a concept which Grade 7 students found difficult.

35. The reason milk kept in a refrigerator does not go sour quickly is that the cold

(7)	changes the water of the milk into ice	☐ 1
(19)	separates the cream	☐ 2
(46)	slows down the action of bacteria	☒ 3
(5)	keeps flies away	☐ 4
(11)	causes a skin to form on the surface	☐ 5
(11)	I don't know	☐ 6

APPENDIX C

Items which require an inappropriately high reading level.

10. Some children were trying to find out which of three light bulbs was brightest. The children said the following things. Which of these gives the best start toward finding the answer?

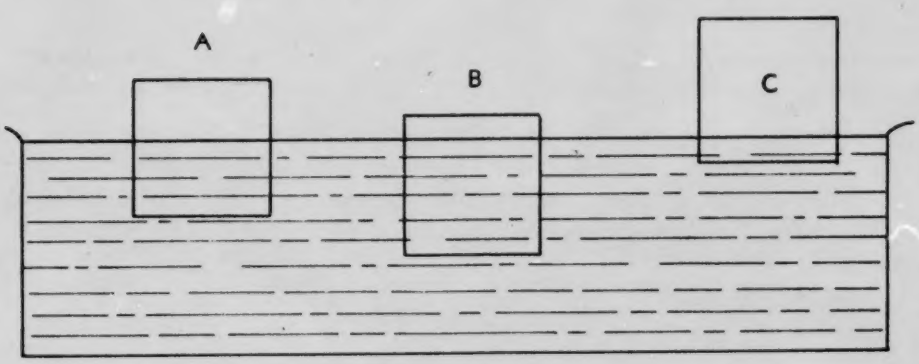
(14) One bulb looks brightest to me so I already know the answer ☐ 1
(13) All the bulbs look bright to me so there can't be an answer ☐ 2
(46) It would help if we had a way to measure the brightness of a light bulb ☒ 3
(20) Let's take a vote; each person will vote for the bulb he thinks is the brightest ☐ 4
(7) I don't know ☐ 5

58. Mary and Dave each bought the same kind of rubber ball. Mary said, "My ball bounces better than yours." Dave replied, "I'd like to see you prove that." What should Mary do?

(64) Drop both balls from the same height and see which bounces higher ☒ 1
(4) Throw both balls against a wall and see how far each ball bounces off the wall ☐ 2
(3) Drop the two balls from different heights and see which bounces higher ☐ 3
(16) Throw the balls down against the floor and see how high they bounce ☐ 4
(11) Feel the balls by hand to find which is harder ☐ 5
(1) I don't know ☐ 6

APPENDIX D

Art work not clear in depicting question.



1. The three solid objects shown above are the same size. If they float as shown, which one weighs the most?

(0)	Object A	☐ 1
(88)	Object B	☒ 2
(7)	Object C	☐ 3
(3)	They all weigh the same	☐ 4
(1)	I don't know	☐ 5

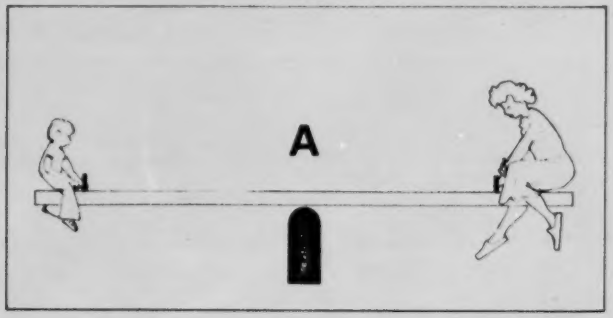
While 88% of the students selected the correct response, panel members felt that:

a) Top of tank should have been left without a solid line.

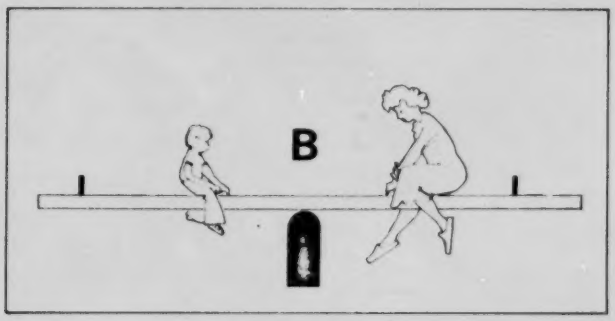
b) Cubes should have been shaded in rather than being white.

c) Water should not be represented by —— - ——.

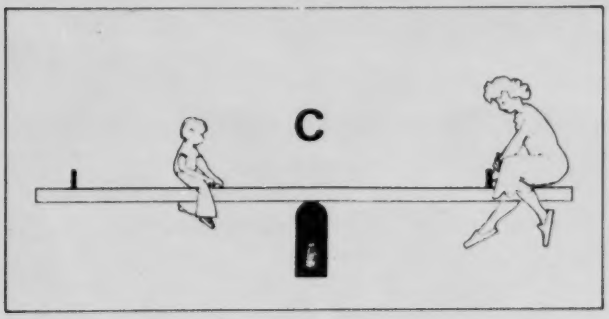
12. Betty wanted to balance on the teeter-totter with her little brother. Which is the best way for them to sit?



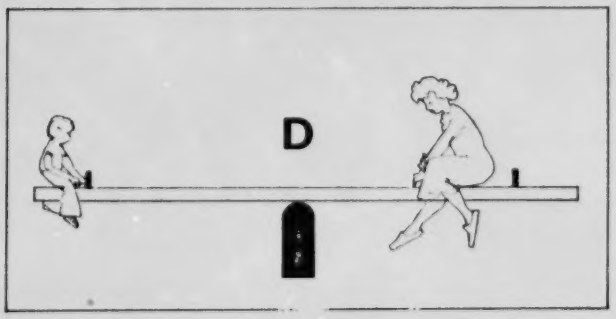
(19) A..... ☐ 1



(12) B..... ☐ 2



(20) C..... ☐ 3



(48) D..... ☒ 4

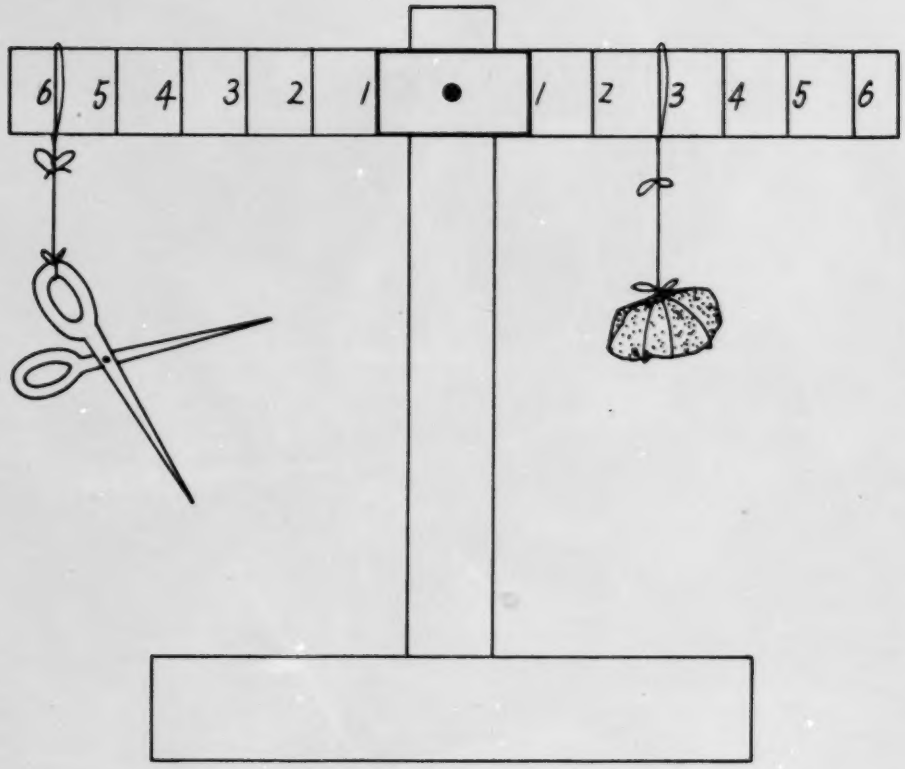
(1) I don't know..... ☐ 5

Comments

1. The best way to sit is "A" with hands on handle.
2. All four pictures show the teeter-totter in balance.

APPENDIX D Cont'd

Look at the picture carefully.



49. From the picture you can say that

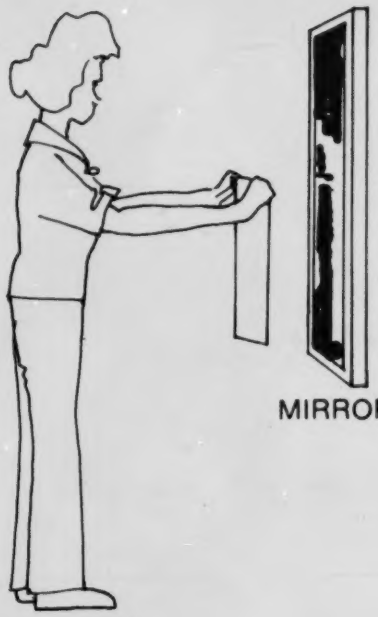
(28) the scissors and the rock weigh about the same..... ☐ 1
(31) the scissors weigh about two times as much as the rock..... ☐ 2
(19) the rock weighs about two times as much as the scissors..... ☒ 3
(18) the rock weighs about three times as much as the scissors..... ☐ 4
(3) I don't know..... ☐ 5

Comments

This is an atypical balance. In fact, given the position of the pivot, it will not function as an accurate balance.

APPENDIX D Cont'd

54.



You hold a paper with the word POPSICLE facing the mirror, as shown in this picture. What does the word look like when you look into the mirror?

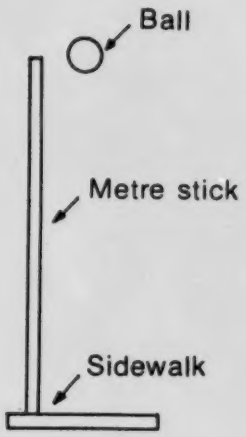
(22)	ELCISPOP	☐ 1
(10)	POPSICLE	☐ 2
(47)	POPSICLE	☒ 3
(19)	ELCISPOP	☐ 4
(1)	I don't know.	☐ 5

How much, if any confusion, was caused by irregular size of letters?

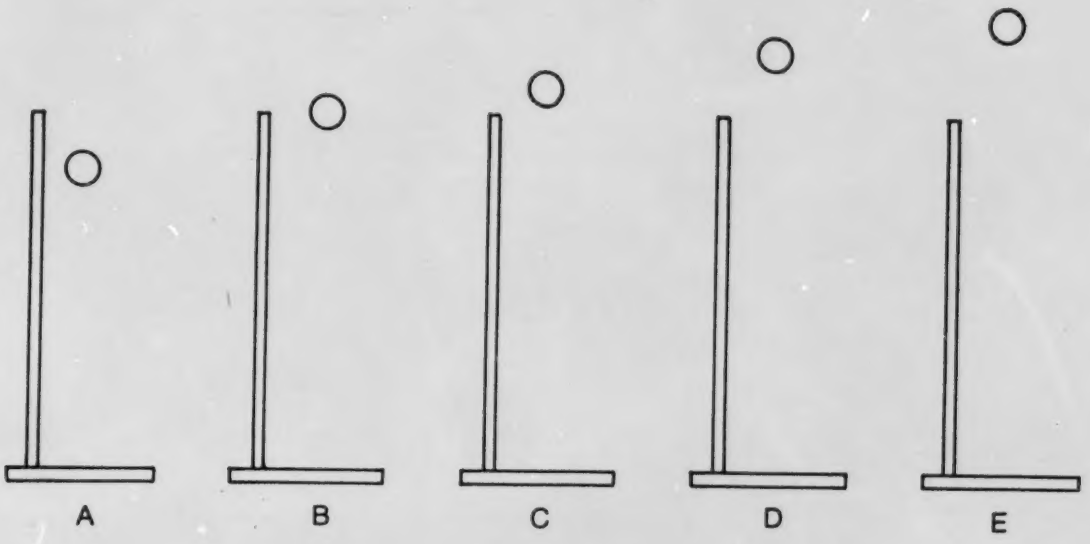
59. Which one of those shown below is the best container to measure the amount of rainfall in millimetres?

(22)	A	☐ 1
(38)	B	☒ 2
(4)	C	☐ 3
(32)	D	☐ 4
(3)	I don't know.	☐ 5

How many students looked for a drawing of an actual rain gauge with its large intake and reduced diameter storage cylinder?



A ball is dropped on the sidewalk from a height of one metre as the picture above shows.



62. Which of the above pictures shows how high the ball could bounce?

(21)	Picture A	☒	1
(15)	B	☐	2
(6)	C	☐	3
(4)	D	☐	4
(51)	E	☐	5
(3)	I don't know	☐	6

How is the ball released? In what direction does it fall?
Where does it land? Use of "could" as opposed to "would"?

There is a lack of background to provide relative height of drop.

APPENDIX D Cont'd

65. While Joe was sitting under a tree, he watched a bird getting insects from between the cracks of the bark. Which drawing shows the kind of beak this bird likely had?

(7) A ..... ☐ 1

(24) B ..... ☐ 2

(2) C ..... ☐ 3

(65) D ..... ☒ 4

(1) I don't know. ..... ☐ 5

The committee members felt that incorrect heads are shown with beaks. Instead, the artist should have ensured that the right shape of head went with the beaks used in the responses.

APPENDIX E

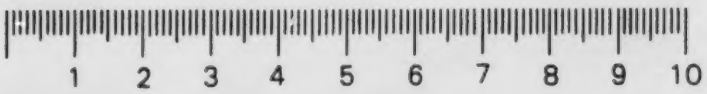
Confusing Ruler.

33. Use the ruler provided to measure the LONG side of this rectangle.

The length is

(3) 11 centimetres..... ☐ 1
(78) 10 centimetres..... ☐ 2
(17) 9 centimetres..... ☐ 3
(1) 8 centimetres..... ☐ 4
(1) I don't know..... ☐ 5

The ruler provided had no "0" and has blank spaces on both ends.



METRIC

APPENDIX F

Test Items Which Have Plausible Responses

5. When Tom threw his rubber ball into the air, it came back to the ground because

(15)	the air pushed it back.	☐ 1
(21)	rubber always bounces back.	☐ 2
(32)	the earth pulled it back.	☒ 3
(20)	the air is very light.	☐ 4
(11)	the earth is a large magnet.	☐ 5
(2)	I don't know.	☐ 6

In the experiences of grade/year 4 students, responses 1,2,3, 4 and 5 are correct.

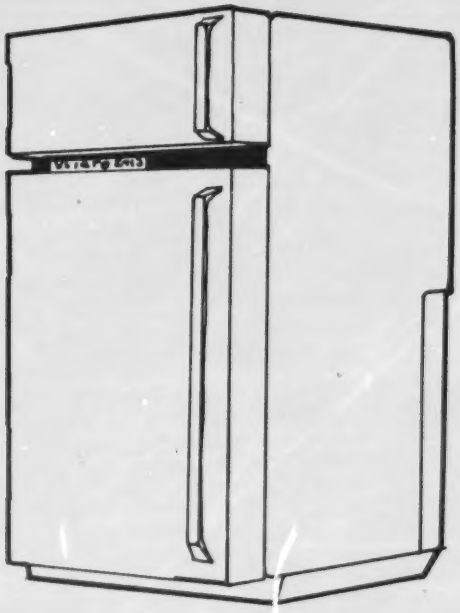
19. Three teaspoons of salt were mixed into a glass of water. How could you get back all the salt?

(33)	Pour the water through a fine paper filter	☐ 1
(3)	Use a magnet on the liquid	☐ 2
(22)	Boil the liquid until all the water is gone	☒ 3
(35)	Let the liquid stand overnight so that all of the salt goes to the bottom	☐ 4
(7)	I don't know	☐ 5

It is interesting to note that,for question 19, students selected responses 1 and 4 with which they would be most familiar. Response #3 would not be within their experience because of the danger of (boiling water) and/or lack of science equipment in room (a hot plate).

Would it not have been more consistent to convert three teaspoons and a glass into metric units?

APPENDIX F Cont'd



42. What will happen to the balloon if it is left in the refrigerator?

(25)	The balloon will crack	☐ 1
(6)	The balloon will get bigger	☐ 2
(11)	The balloon will stay the same	☐ 3
(54)	The balloon will get smaller	☒ 4
(3)	I don't know	☐ 5

While response #4 is the desired one, response #1 also is correct.

Is refrigerator plugged into an electrical outlet?

Refrigerator or any cold environment?

43

APPENDIX F Cont'd

Here are two pictures of a pot of water on a stove. Picture 2 was taken 5 minutes after picture 1.

PICTURE 1

PICTURE 2

55. Which choice is the best way of telling that there has been a CHANGE?

(17)	The water is boiling in picture 2	☐ 1
(8)	The gas is on in picture 2	☐ 2
(8)	The water gets hot when the gas is on	☐ 3
(4)	The water is not boiling in picture 1	☐ 4
(61)	The water is boiling in picture 2, but it is not boiling in picture 1	☒ 5
(2)	I don't know	☐ 6

While 61% of the students selected the "correct" response, responses #1, #2, #3 are correct in that they show a change.

APPENDIX G

Selected Comments of the March 1, 1977 Report of the District Review Committee of School District #39, Vancouver on Reading Assessment (Grade/Year 4) - Language B.C.

1."The 'typical' performance of Vancouver Students in 'using structural analysis' fell below the range of acceptable performance defined by the district review panel. Structural analysis is particularly difficult for children whose first language is not English. These children have difficulty with prefixes, suffixes, root words and compound words." (page 9)

2."The average performance of Vancouver students on all items relating to objective 2.3 (determining the sequence of events) was significantly below the provincial performance. Does this difference in performance reflect a difference in social milieu and background?" (page 10)

3. Girls out-perform boys.

4. The more schools attended, the lower the reading performance.

5. Native born Canadians score higher than non-natives.

6. Solely English speakers score higher than non English speakers.

7. Younger students (9 and under) out-perform older (over 9) students.

APPENDIX B

REPORT OF THE INTERPRETATION PANEL ON SCIENCE,

GRADE 8 LEARNING ASSESSMENT

REPORT OF THE INTERPRETATION PANEL ON SCIENCE, GRADE 8 LEARNING ASSESSMENT NOVEMBER, 1978

The Science tests for Grade 8 were designed to assess students' mastery of eleven objectives which were grouped into five goals as indicated in Table I. Both Goals 1 and 2 contained four objectives whereas Goals 3, 4 and 5 were each represented by a single objective which had the same description as its goal.

The 92 test items were divided into test booklets A and B, each of which was administered to approximately one half of the Grade 8 student population in British Columbia during March, 1978. The test items from each test booklet have been combined for the purpose of analyzing student performance.

INTERPRETATION PROCESS OF STUDENT PERFORMANCE

The Grade 8 Interpretation Panel which consisted of a principal, four science teachers and two School Board coordinators followed the Guidelines For Interpretation Of District Assessment Results published by the Ministry of Education. Before examining the test results, each committee member independently established two levels of performance, "acceptable" and "desired", for each test item. "Acceptable" performance was expressed by the minimum percentage of students that each panel member felt must be able to complete an item correctly in order for performance to be considered satisfactory. Performance below the acceptable level would be considered indicative of a weakness. "Desired" performance was expressed by the percentage of students in the district that the evaluator would like to see complete each item correctly--a goal toward which to strive. Performance above the desired level would be considered as indicative of a strength.

After examining the district results, the panel members compared the actual percentage of Vancouver students who correctly responded to each item with the pre-established range of acceptable and desired performances. Using this range as a general focus in discussion, members reached a consensus of opinion by rating the performance on each test item along the following five-point continuum of satisfaction.

5 = Strength (St)
4 = Very Satisfactory (VS)
3 = Satisfactory (S)
2 = Marginal Performance (MP)
1 = Weakness - Poor Performance (W)

Table II shows the panel's ratings of student performance on each test item and the overall ratings for each objective. Table III in summary form lists the overall ratings of student performance for each objective. These tables were used to assist in the analysis of student performance and in making suggestions for improvement. The panel members' comments on the suitability of the test items accompany the tables.

ANALYSIS OF STUDENT PERFORMANCE

As the summary of ratings in Table III indicates, Grade 8 students in Vancouver schools performed in a "satisfactory" manner for three of the four objectives in Goal 1: Concepts and Knowledge. The three objectives for which student performance was rated "satisfactory" were:

1.1 Biology Concepts
1.3 Physics Concepts
1.4 Earth/Space Concepts

Although Objective 1.1 Biology Concepts was given a "satisfactory" rating, panel members indicated that student performance on the health and nutrition test items within this objective was weak. A "marginal performance" rating was given to the fourth objective 1.2 Chemistry Concepts, even though the panel members believed that five test items are too few for an adequate assessment of this content area. Generally, the panel was satisfied with student achievement in the Concepts and Knowledge test items.

Panel members rated the four objectives in Goal 2: Processes as either "strength", "very satisfactory", or "satisfactory". Student performance in Objective 2.1 Classifying was given the highest rating of "strength" whereas Objective 2.2 Communicating and 2.3 Measuring were assigned the second highest rating of "very satisfactory". Objective 2.4 Combined Skills was given a "satisfactory" rating for student performance.

For the last three objectives in the Science test for Grade 8, Applications, Safety and Scientific Literacy, panel members rated student achievement as "marginal performance". More attention to these areas is suggested by panel members.

RECOMMENDATIONS

The following recommendations were made by members of the Grade 8 Interpretation Panel for Science.

1. At the elementary school level more "hands on" science activities such as conducting experiments and taking notes would assist in improving student performance in Goal 3: Applications. Students need more practice in applying knowledge to different situations

by utilizing their higher levels of intellectual thought (i.e. application, analysis, synthesis and evaluation).

2. Elementary school staffs should ensure that sufficient time is being allotted for science education.

3. Students need instructions and demonstrations on laboratory safety which should be introduced early in each science course. Booklets on safety such as the Laboratory Science Safety Guide* and the Fisher Manual of Laboratory Safety**, should be distributed to all Science teachers throughout British Columbia.

4. At the secondary school level teachers should ensure that there is not an overemphasis on laboratory activities that require following instructions to the detriment of interpretive discussion which is needed to improve performance on Goal 5: Scientific Literacy. Oral discussion of scientific concepts and applications is as important as the laboratory work which illustrates these principles.

Members Of The Interpretation Panel For Provincial Learning Assessment In Science, Grade 8, 1978:

Larry Levchuk, Killarney
Doug McLeod, John Oliver
Allan Moodie, V.S.B.
Hart Scarrow, Killarney
Russ Selwood, Byng
Min Sugimoto, Killarney
John Uzelac, V.S.B.

*Laboratory Science Safety Guide (Prepared and produced jointly by the British Columbia Teachers' Federation and the Department of Education), Victoria, B.C., 1975. 10pp. (Currently under revision).

**Fisher Manual of Laboratory Safety Bulletin No.202 (Can.) Pittsburgh, Pa.: Fisher Scientific Company, 1972. 60pp.

TABLE I: Goals And Objectives In The Science Assessment Of Grade 8 Students During March, 1978

Goal	Objectives	Number Of Items
1. Concepts and Knowledge	1.1 Biology Concepts	8
	1.2 Chemistry Concepts	5
	1.3 Physics Concepts	10
	1.4 Earth/Space Concepts	8
2. Processes	2.1 Classifying	5
	2.2 Communicating	7
	2.3 Measuring	8
	2.4 Combined Skills	10
3. Applications	3.-	15
4. Safety	4.-	6
5. Scientific Literacy	5.-	10
	Total =	92

TABLE II: Interpretation Form

Objective	Item Number	Actual Performance (Percent Correct)	Panel Rating	Comments/ Reasons
1.1 Biology Concepts	A16	91%	St)	The overall rating is "satisfactory". Student performance on health and nutrition test items is generally weak.
	A24	87	VS)	
	A27	45	W)	
	A36	42	MP)	
	A38	72	S)	
	B15	31	W)	
	B31	43	W)	
	B44	71	S)	
1.2 Chemistry Concepts	A17	30%	W)	The overall rating is "marginal performance". The number of test items is too limited for an adequate evaluation of chemistry concepts.
	A31	61	VS)	
	A43	82	VS)	
	B03	68	MP)	
	B40	51	W)	
1.3 Physics Concepts	A01	82%	St)	The overall rating is "satisfactory".
	A10	34	W)	
	A18	70	VS)	
	A32	69	St)	
	A46	42	MP)	
	B02	69	W)	
	B10	50	W)	
	B19	40	W)	
	B36	64	S)	
	B45	45	MP)	
1.4 Earth/Space Concepts	A03	43%	W)	The overall rating is "satisfactory".
	A15	33	W)	
	A25	24	W)	
	A42	75	VS)	
	B04	47	S)	
	B18	68	VS)	
	B26	79	VS)	
	B39	82	VS)	
2.1 Classifying	A21	53%	VS)	The overall rating is "strength".
	A22	84	St)	
	A23	88	St)	
	B17	90	St)	
	B29	72	St)	

TABLE II (cont'd)

Objective	Item Number	Actual Performance (Percent Correct)	Panel Rating	Comments/ Reasons
2.2 Communicating	A11	76%	VS)	The overall rating is "very satisfactory".
	A37	68	VS)	
	A44	57	S)	
	B05	69	VS)	
	B06	45	S)	
	B23	68	S)	
	B46	90	St)	
2.3 Measuring	A12	69%	St)	The overall rating is "very satisfactory".
	A19	26	W)	
	A28	92	St)	
	A41	59	S)	
	B11	91	St)	
	B21	90	St)	
	B27	42	MP)	
	B38	17	W)	
2.4 Combined Skills	A04	35%	MP)	The overall rating is "satisfactory".
	A05	58	S)	
	A06	37	S)	
	A30	74	S)	
	A39	79	S)	
	B01	86	VS)	
	B12	35	W)	
	B20	38	W)	
	B32	78	S)	
	B42	63	VS)	
3 Applications	A02	79%	VS)	The overall rating is "marginal performance".
	A08	28	W)	
	A14	79	VS)	
	A20	44	W)	
	A29	44	MP)	
	A35	60	S)	
	B07	64	MP)	
	B09	21	W)	
	B13	87	St)	
	B16	73	VS)	
	B22	5	W)	
	B25	55	MP)	
	B30	44	W)	
	B33	38	W)	
	B35	79	VS)	

TABLE II (cont'd)

Objective	Item Number	Actual Performance (Percent Correct)	Panel Rating	Comments/ Reasons
4 Safety	A09	92%	VS)	The overall rating is "marginal performance". Students need specific instruction and demonstrations on safety.
	A33	31	W)	
	A45	74	W)	
	B14	72	S)	
	B34	29	W)	
	B41	83	S)	
5 Scientific Literacy	A07	79%	VS)	The overall rating is "marginal performance".
	A13	33	W)	
	A26	54	W)	
	A34	69	VS)	
	A40	49	W)	
	B08	63	W)	
	B24	70	MP)	
	B28	85	VS)	
	B37	84	MP)	
	B43	27	W)	

LEGEND FOR PANEL RATINGS

St = Strength
VS = Very Satisfactory
S = Satisfactory
MP = Marginal Performance
W = Weakness - Poor Performance

TABLE III: Overall Ratings Of Student Performance In The Science Test For Grade 8

Goal	Objectives	Overall Ratings
1. Concepts and Knowledge	1.1 Biology Concepts	Satisfactory
	1.2 Chemistry Concepts	Marginally Satisfactory
	1.3 Physics Concepts	Satisfactory
	1.4 Earth/Space Concepts	Satisfactory
Student performance in Goal 1 is generally "satisfactory".		
2. Processes	2.1 Classifying	Strength
	2.2 Communicating	Very Satisfactory
	2.3 Measuring	Very Satisfactory
	2.4 Combined Skills	Satisfactory
Student performance in Goal 2 is generally "very satisfactory".		
3. Applications	3.-	Marginal Performance
4. Safety	4.-	Marginal Performance
5. Scientific Literacy	5.-	Marginal Performance

APPENDIX A: Suggestions For Modifying The Test Items In The Grade 8 Learning Assessment Of Science, 1978

1. For test item A03 the panel believed that the words in the alternative choices such as "revolving" and "spinning" have similar meanings and may be confusing to students. A suggested modification to the first alternative choice was "earth travelling around the sun". This change would have avoided possible confusion with the earth's rotating motion on its axis which causes day and night.

2. In test item A44 several alternative choices are plausible answers to the question.

3. In test item B27 the panel indicated that the wording was not clear enough for the reading level of Grade 8 students.

4. Test item B38 assesses a skill which may be of minor significance as many rulers have an indented zero mark.

5. Test items A04 and B12 are too wordy and complex for weak readers.

6. In test item A20 the word "dropped" should be underlined for emphasis or expanded to "dropped, not thrown". Students' direct experience of this situation generally comes from throwing a ball downwards.

7. In test item A29 the alternative choices are discriminating at a very high conceptual level for Grade 8 students. Without additional data, several of the distractors are valid choices.

8. Test items A08 and B22 should be considered knowledge rather than application questions. In B22 most Grade 8 students knew only that "paper" was a wood product and therefore could not apply knowledge of the product "alcohol" to the general product class of "disinfectants".

9. In item A13 several choices could be considered as belonging to the hypothesis classification at the Grade 8 level.

10. The panel questions whether test item B43 is a measure of scientific literacy. (see additional comment #3 in Appendix B).

11. The diagram in item B13 shows an incorrect "mid-day" tree shadow as no space is allotted for the trunk shadow.

12. For item B06, the correct extrapolated value for choice B should read 80 metres, not 75 metres.

13. Item A19 requires the use of decimal and place values skills. This question may have been measuring these Mathematics concepts which was a weak area identified by the previous Mathematics assessment.

APPENDIX B: Additional Comments

1. It was the opinion of the panel that P values were reduced in some cases by the length and/or complexity of the problem statement. (e.g. A04, B12, B27). Additionally, P values could be increased if students at this level had more experience with strategies for answering multiple choice tests;

   i.e. careful reading of the problem statement;
   determination of the true question being asked;
   formulation of an initial answer before checking distractors;
   elimination of 'poor' distractors; and
   final check of chosen answer against problem statement.

2. For teachers evaluating the test results for possible curricular or program implications, the item analysis data (Table 4, p. B12 - District Report For Science Grade 8, School District #39 Vancouver) may be very helpful;

   i.e. cases of powerful distractors revealing possible fallacious or simplistic reasoning (A17, A25);
   relatively even spread among choices indicating lack of teaching emphasis (A08, A13, B09, B30); and
   implications of questions with high percentage of 'I don't know' answers (A19, A40, B04, B06) or multiple answers (A01, A13, A25, A37, A42, B37).

3. In reviewing the questions, the panel encountered some disagreement with the stated definition of Scientific Literacy. It was felt that several questions pertaining to this goal contained a large attitudinal component and thus did not encourage scientific interpretation.

4. In light of the tendency toward limited, centralized text choice, the panel feels that much effort should be expended in producing and disseminating to practising teachers a wide range of support materials. These could include:

   subject- or topic-centered monographs;
   teacher and specialist produced lesson aids;
   multi-media resources such as tapes, filmstrips and charts, keyed to texts and/or curriculum guides;
   test item banks cross-referenced to key grade- and subject-level concepts; and
   in-service and/or written reference materials related to prescriptive and evaluative test construction, with emphasis on criterion-referenced items.

APPENDIX C

REPORT OF THE INTERPRETATION PANEL ON SCIENCE,

GRADE 12 PROVINCIAL LEARNING ASSESSMENT PROGRAM

1978-12-06

REPORT OF THE INTERPRETATION PANEL ON SCIENCE, GRADE 12

PROVINCIAL LEARNING ASSESSMENT PROGRAM, MARCH 1978

GOALS OF SCIENCE TEACHING

The first task in the science assessment was to identify the major goals of science education and to develop a blueprint for the tests in the form of a framework of instructional objectives. Six major goals were identified:

GOAL 1

Understanding Concepts, which includes:

the knowledge and comprehension of important models, generalizations, theories, principles, ideas and concepts of science, such as the principles of electrical circuits, the concept of biological variation, the structure of atoms, or the processes of mountain formation.

GOAL 2

Skill in the Processes of Science, which includes:

a) observing (carefully noting the characteristics or properties of things or the sequence of events),

b) classifying (grouping things according to shared characteristics or properties),

c) communicating (reporting observations and conclusions in appropriate ways, interpreting information which has been communicated in a scientific way),

d) measuring (understanding units of measurement, choosing appropriate measuring instruments, using measuring instruments correctly), and

e) combined skills (designing experiments, controlling variables, interpreting data).

GOAL 3

Application, which includes:

the ability to apply scientific knowledge to given problems and the knowledge of the way in which scientific principles are applied in the practical world.

GOAL 4

Safety, which includes

the knowledge of safe procedures and precautions in the use of hazardous materials and equipment in the laboratory, the classroom, or the home.

GOAL 5

Scientific Literacy, which includes

> understanding and appreciation of the nature of science and its methods, and the ability to interpret discussion of science-related issues.

GOAL 6

Favourable Attitudes to Science and Scientists, such as

> favourable attitudes to scientists as people, and towards science as a school subject, as a career, and, as an interest.

The achievement of this goal was assessed by an inventory of attitudes. The analysis of responses is not included in this report.

THE TESTS

The first five goals--concepts, process, application, safety, and scientific literacy--were assessed using multiple-choice tests at the grades four, eight and twelve levels. The tests covered four broad areas of science content:

- biology
- chemistry
- physics
- earth and space sciences

The science tests for Grade 12 were designed to assess students' mastery of eleven objectives which were grouped into five goals as indicated in Table I. Both Goals 1 and 3 contained four objectives whereas Goals 2, 4 and 5 were each represented by a single objective which had the same description as its goal.

The 120 test items were divided into test booklets A and B, each of which was administered to approximately one half of the Grade 12 student population* in British Columbia during March, 1978. The test items from test booklets A and B have been combined for the purpose of analyzing student performance.

The major emphasis in the Grade 12 assessment was on the understanding of science concepts (41 items) and on the application of scientific knowledge to problems (32 items). On the other hand, the skill of students in the processes of science was tested by a group of 21 items. This seemed to the panel to be an imbalance for the reason that the present science program appears to focus on processes of science. The panel is of the opinion that the provincial science program, particularly at the junior secondary level, should be modified to direct greater attention to the acquisition of science knowledge and a greater emphasis on practical applications of science.

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*The tests were written by 26,416 Grade 12 students, 79% of the February enrolment.

TABLE I: GOALS AND OBJECTIVES IN THE SCIENCE ASSESSMENT OF GRADE 12 STUDENTS DURING MARCH, 1978

Goal	Objectives	Number Of Items
1. Concepts and Knowledge	1.1 Biology Concepts	11
	1.2 Chemistry Concepts	9
	1.3 Physics Concepts	11
	1.4 Earth/Space Concepts	10
2. Processes	2.- Combined Skills	21
3. Applications	3.1 Biology	10
	3.2 Chemistry	7
	3.3 Physics	9
	3.4 Earth/Space	6
4. Safety	4.-	6
5. Scientific Literacy	5.-	20
	TOTAL	120

In addition to items that assessed science achievement, there were twelve questions about the background of the students. The analysis of the background information was used by the interpretation panel in establishing expectations of student performance.

The testing time for the science assessment was one hour (60 minutes). This included the time necessary for student preparation, the collection of background information and for the answering of the test items. The time allotment was sufficiently generous to allow almost all students to complete the test comfortably.

Form A of the test was written by 1,904 Grade 12 students in Vancouver; Form B by 1,830 students. The total of 3,734 represented 78 percent of the Grade 12 enrolment in February, 1978.

Slightly more than half (50.6%) of the students writing were female. The median age of those writing the test was 17 years, 11 months. In this respect the Vancouver population was very similar to that of the province as a whole. Most of the students reported that they spend from 60 to 90 minutes per week on science homework. The Vancouver students appeared to do slightly more homework than the provincial average.

A slightly larger proportion of Vancouver students appeared to have taken advanced electives in science than was the case in the rest of the province. Thirty-nine point four percent were taking science 12 courses. Thirty-four point two percent had not taken any science courses beyond Grade 10.

More than half (55.8%) of the students have a job and of this group the typical student spends between 10 and 20 hours on it per week. The highest level of education completed by the father, mother or guardian of the typical student was senior secondary school. In this respect the Vancouver group was not significantly different from the provincial population.

The plans of Vancouver students after they leave secondary school are somewhat different from those of the provincial population. Larger proportions of the group plan to go to university, community college and technical institutes. Somewhat smaller proportions of Vancouver students plan to seek employment, take trade training or take a year off before returning to an educational program.

The occupations of the fathers or guardians of Vancouver students was similar to those of the provincial population, except that a larger proportion (12.4% compared to 9.9%) were professionals and a somewhat larger proportion (5.6% compared to 3.2%) were labourers.

The occupations of mothers or guardians of Vancouver students were similar to those of parents of students in the provincial population, except that a larger proportion (11.9% compared to 5.6%) were employed in unskilled or semi-skilled work. and a somewhat smaller proportion (40.7% compared to 43.5%) were homemakers.

INTERPRETATION PROCESS OF STUDENT PERFORMANCE

The Grade 12 interpretation panel included the following persons:

John Allan	- Assistant Superintendent, East Area
Cary Chien	- David Thompson Secondary School
Norm Ellis	- Head of Evaluation and Research Services
Richard Hopkins	- King George Secondary School
Bill Jacobsen	- Vice-Principal II, Vancouver Technical Secondary
Bruce Wood	- David Thompson Secondary School (CHAIRMAN)
John Worobec	- Science Department Head, Magee Secondary School

The panel followed the Guidelines for Interpretation of District Assessment Results published by the Ministry of Education. Before examining the test results, each committee member independently established two levels of performance, "acceptable" and "desired", for each test item. "Acceptable" performance was expressed as the minimum percentage of students that one felt must be able to complete an item correctly in order for performance to be considered satisfactory. Performance below the "acceptable" level would be considered indicative of a weakness. "Desired" performance was expressed as the percentage of students in the district that the evaluator would like to see complete each item correctly--a goal toward which to strive. Performance above the desired level would be indicative of a strength.

After examining the district results, the panel members compared the actual percentage of Vancouver students who correctly responded to each item with the pre-established range of acceptable and desired performances. Using this range as a general focus in discussion, members reached a consensus of opinion by rating the performance on each test item along the following five-point continuum of satisfaction.

5 = Strength (St)
4 = Very Satisfactory (VS)
3 = Satisfactory (S)
2 = Marginal Performance (MP)
1 = Weakness - Poor Performance (W)

Of the 120 items on the Grade 12 test, the panel rated performance on eight as weak, 43 as marginal, 48 satisfactory, 18 as very satisfactory, and three as strong. Performance was rated as satisfactory or better on 57.5 percent of the items. The interpretation panel's ratings are summarized in Table II.

The overall results on this test, under the circumstances of the provincial learning assessment, were slightly less than satisfactory.

TABLE II

INTERPRETATION PANEL JUDGMENTS OF THE ACHIEVEMENT OF EACH OBJECTIVE ON THE GRADE TWELVE TEST FOR VANCOUVER SCHOOLS

(Provincial results in parentheses)

Goal	Number of items assigned by the panel to each rating category					Average Rating
	"1" Weak	"2" Marginal	"3" Satisfactory	"4" Very Satisfactory	"5" Strong	
Understanding Concept						
- Biology	2 (1)	3 (6)	4 (3)	1 (0)	1 (1)	2.6 (2.5)
- Chemistry	1 (3)	2 (4)	4 (0)	1 (2)	1 (0)	2.9 (2.1)
- Physics	2 (3)	2 (5)	4 (1)	3 (1)	0 (1)	2.7 (2.3)
- Earth/Space	1 (2)	4 (6)	5 (1)	0 (1)	0 (0)	2.4 (2.1)
Process						
- Combined Skills	0 (6)	9 (10)	10 (3)	2 (2)	0 (0)	2.7 (2.1)
Application						
- Biology	0 (3)	4 (2)	2 (4)	4 (0)	0 (1)	3.0 (2.4)
- Chemistry	0 (6)	6 (1)	1 (0)	0 (0)	0 (0)	2.1 (1.1)
- Physics	2 (4)	4 (5)	3 (0)	0 (0)	0 (0)	2.1 (1.6)
- Earth/Space	0 (4)	4 (1)	2 (1)	0 (0)	0 (0)	2.3 (1.5)
Safety	0 (2)	2 (1)	1 (1)	2 (2)	1 (0)	3.3 (2.5)
Scientific Literacy	0 (5)	3 (4)	12 (8)	5 (2)	0 (1)	3.1 (2.5)
TOTAL TEST	8 (39)	43 (45)	48 (22)	18 (10)	3 (4)	2.7 (2.1)
% OF TEST ITEMS	6.7%	35.8%	40%	15%	2.5%	

Table III shows the panel's ratings of student performance on each test item and the overall ratings for each objective. This table was used to assist in the analysis of student performance and in making suggestions for improvement.

TABLE III: SUMMARY OF PERFORMANCE RATINGS,

PROVINCIAL LEARNING ASSESSMENT IN SCIENCE, GRADE 12, 1978

Objective		Item Number	District Performance	Rating	Comments/Reasons
1.1	.1	A02	94	5	
	.2	A14	52	1	
UNDER-	.3	A31	66	3	
STANDING	.4	A34	55	1	
BIOLOGY	.5	A44	51	2	
CONCEPTS	.6	A52	51	3	
	.7	B03	60	2	
	.8	B15	61	2	
	.9	B33	72	4	There was some dissatisfaction with the foils in this item.
	.10	B35	66	3	Alternative responses are not consistent in the level of terminology used. It would be better, for example, to replace "food" with "carbohydrates".
	.11	B60	50	3	
1.1		AVERAGE	60.9	2.6	While the overall performance is marginally satisfactory, there was some serious weakness in basic biology concepts and health knowledge. How well do students transfer to the study of human biology understandings of biological concepts in other animals?
1.2	.1	A03	55	3	The printing error caused confusion.
	.2	A15	77	4	
UNDER-	.3	A32	38	2	
STANDING	.4	A50	56	3	
CHEMISTRY	.5	A58	37	2	
CONCEPTS	.6	B02	55	3	
	.7	B16	78	5	
	.8	B36	22	3	Poor question. Chemical equilibrium is a topic included in Chemistry 12.
	.9	B43	23	1	A student in Grade 12 should know the products of combustion.
1.2		AVERAGE	48.7	2.9	Generally satisfactory performance. There are other items that might be more representative of the present curriculum; example, balancing an equation or a problem on percentage composition.
1.3	.1	A01	51	3	
	.2	A07	56	3	Although nuclear energy appears to be beyond the scope of Science 10, it should become an integral part of the science program. Correct response to the item depends on a careful reading of the words "finally delivered".
UNDER-					
STANDING					
PHYSICS					
CONCEPTS					
	.3	A30	36	1	
	.4	A33	71	4	
	.5	A35	49	3	This item properly belongs in the section on applications. It does not seem to be specific to any science curriculum.
	.6	A57	49	2	
	.7	B01	83	4	

Legend for Ratings

5 = Strength
4 = Very Satisfactory
3 = Satisfactory
2 = Marginal Performance
1 = Weakness - Poor Performance

Objective		Item Number	District Performance	Rating	Comments/Reasons
1.3	.8	B14	72	4	
	.9	B34	32	3	
UNDER-STANDING	.10	B37	53	2	
PHYSICS CONCEPTS	.11	B47	47	1	
1.3		AVERAGE	54.7	2.7	Overall performance was generally satisfactory. Items on force and energy were poorly done; e.g. 1.3.11 (B47).
1.4	.1	A05	31	2	The testing of this knowledge might have been accomplished in a simpler fashion. Why use a circle graph? Why must the air be humid?
UNDER-STANDING	.2	A18	44	2	The alternative responses should be more plausible.
EARTH/	.3	A29	30	3	
SPACE	.4	A43	47	2	
CONCEPTS	.5	A45	35	2	Foil C appears to be a strong distractor, perhaps too strong.
	.6	A49	61	3	
	.7	B06	68	3	
	.8	B46	43	3	This is a trick item. It would be better if in the first sentence "(sodium chloride)" was removed.
	.9	B50	50	3	In the diagram the location of the observer should be specified.
	.10	B59	21	1	This concept could be tested in a much simpler fashion.
1.4		AVERAGE	43.3	2.4	The overall performance was marginal. Weaknesses in test items may have contributed to the poor performance. Knowledge of space science should be improved by integrating many of these concepts into the science program.
			OVERALL PERFORMANCE	OVERALL RATING	
GOAL 1			52.3	2.7	Slightly less than satisfactory. The present program is "process" oriented and the panel suggests that there is a need for a somewhat greater focus on the understanding of scientific models and basic concepts.
2.1	.1	A09	37	2	Intent of this set of questions is good, but it is probably too long. It places a great demand on reading ability.
	.2	A10	44	3	
PROCESSES	.3	A11	22	2	
	.4	A12	28	2	
	.5	A13	45	2	

Objective		Item Number	District Performance	Rating	Comments/Reasons
2.1	.6	A36	41	3	
	.7	A37	84	4	
PROCESSES	.8	A38	18	2	
	.9	A39	63	3	
	.10	A40	56	3	
	.11	B08	54	2	
	.12	B09	23	2	
	.13	B10	64	3	
	.14	B11	39	2	
	.15	B12	58	3	
	.16	B13	45	2	
	.17	B38	68	3	
	.18	B39	57	3	
	.19	B40	49	3	These are good items.
	.20	B41	52	3	
	.21	B42	71	4	
2.1		AVERAGE	48.2	2.7	Although the questions were fairly demanding, the performance on this section was slightly less than satisfactory. It is hard to pinpoint specific difficulties. More emphasis should be placed on the reading of graphs, charts and tables.
3.1	.1	A16	69	4	
	.2	A17	67	4	
APPLICA-	.3	A22	54	3	
TIONS --	.4	A48	46	2	The diagram is confusing.
BIOLOGY	.5	B05	83	4	
	.6	B17	75	4	
	.7	B18	51	2	
	.8	B51	19	2	The question is weak. The answer should have referred to the basic principle of transfusion.
	.9	B52	54	2	
	.10	B55	64	3	
3.1		AVERAGE	58.4	3.0	Student achievement in this objective was satisfactory. Superior performance on biology items was noted.
3.2	.1	A42	15	2	
	.2	A53	44	2	
APPLICA-	.3	A55	33	2	
TIONS --	.4	B07	11	2	
CHEMISTRY	.5	B22	44	2	
	.6	B45	44	3	
	.7	B56	32	2	
3.2		AVERAGE	31.6	2.1	Although student performance on this section was marginal, the panel suggest that some of the questions do not test the applications of chemistry, e.g. A42, B07, B56, A55; and the assessment might have included items that are more representative of chemistry applications.

Objective		Item Number	District Performance	Rating	Comments/Reasons
3.3	.1	A04	11	1	
	.2	A28	46	2	
APPLICA-	.3	A47	58	3	
TIONS --	.4	A51	54	3	The model represented in the diagram is poor.
PHYSICS	.5	A60	37	2	
	.6	B04	18	1	Beyond the scope of the science program.
	.7	B23	31	2	
	.8	B53	42	2	
	.9	B54	60	3	The use of the word "main" was criticized.
3.3		AVERAGE	39.6	2.1	Student performance on this section was marginal. Insofar as lab work is concerned, it should be related to practical applications of physics principles. Performance of students was particularly weak in items 3.3.1 and 3.3.6. This section contained many good questions.
3.4	.1	A41	30	2	
	.2	A59	35	3	
APPLICA-	.3	B32	50	3	
TIONS --	.4	B44	25	2	This appeared to the committee to be a trick question.
EARTH/ SPACE	.5	B57	34	2	
	.6	B58	26	2	
3.4		AVERAGE	33.0	2.3	Performance on this objective was marginal but there may be little attention to this objective because of the senior science courses being offered in Biology, Chemistry and Physics.
			OVERALL PERFORMANCE	OVERALL RATING	
GOAL 3			42.6	2.4	The performance was marginal on items testing the applications of science. More attention should be given to practical applications of science principles.
4	.1	A06	93	5	
	.2	A23	62	3	
SAFETY	.3	A54	53	2	
	.4	B29	75	4	Good items.
	.5	B30	33	2	
	.6	B31	83	4	
4		AVERAGE	66.4	3.3	Performance was satisfactory. Students appear to understand basic principles of safety in the science lab.

Objective	Item Number	District Performance	Rating	Comments/Reasons
5 .1	A08	81	4	
.2	A19	63	3	
SCIENTIFIC .3	A20	53	3	
LITERACY .4	A21	60	3	
.5	A24	55	3	
.6	A25	21	2	
.7	A26	77	4	
.8	A27	38	2	
.9	A46	41	3	
.10	A56	57	3	
.11	B19	66	3	
.12	B20	25	3	
.13	B21	88	4	
.14	B24	40	3	
.15	B25	76	4	
.16	B26	60	3	
.17	B27	38	2	
.18	B28	77	4	
.19	B48	48	3	For this item, "I don't know" would be a better response.
.20	B49	53	3	
5	AVERAGE	55.9	3.1	In view of the high percentage of students in School District 39 for whom English is a second language, the panel views as "satisfactory" the performance in the Scientific Literacy section.

ANALYSIS OF STUDENT PERFORMANCE

Goal 1 - Understanding of Science Concepts

The overall performance was slightly less than satisfactory on the understanding of science concepts. The present science program is "process-oriented" and the panel suggests that there is a need for a somewhat greater focus on scientific models and fundamental concepts.

Goal 2 - Processes of Science

The performance of Vancouver students on items that tested the processes of science was slightly less than satisfactory. However, the evaluation of process goals by means of multiple choice items is difficult. The panel members consider that teachers should place more emphasis on the reading of graphs, charts and tables.

Goal 3 - Application of Scientific Principles

The overall performance of students on Goal 3 on the application of scientific principles was marginal. The panel suggests that more attention be given to practical applications of scientific principles. Students appeared to perform at a superior level on items testing the application of principles of biology.

Goal 4 - Safety

The performance of students on items testing Goal 4 suggests that students understand the basic principles of safety in the laboratory, classroom and home. This may reflect the emphasis of the present program on laboratory skills.

Goal 5 Scientific Literacy

The performance of Vancouver students was satisfactory on items that test their scientific literacy.

Growth in Science Knowledge

The panel notes the growth in science knowledge as evidenced by the performance of Vancouver students on items that were common in the assessments of Grades 8 and 12; for example, on item 1.1.7 (B03) the performance in Grade 8 was 31% as compared to 60% in Grade 12, on item 1.1.10 (B35) the performance in Grade 8 was 43% as compared to 66% in Grade 12, on item 1.4.2 (A18) the performance in Grade 8 was 24% as compared to 44% in Grade 12, and on item 4.-.4 (B29) the performance in Grade 8 was 29% as compared to 75% in Grade 12.

Table 5, page 31, of the Summary Report compares results by the highest science course taken. Students who had taken some science in Grade 11 performed better than those who had no science course beyond Grade 10. Similarly, those who were taking a science in Grade 12 performed at a higher level than the other two groups. The differences in performance measured up to the expectations of the panel.

The comparison presented in Table 4, page 29 of the Summary Report from the contract team to the Ministry of Education, was reviewed by the panel and it observed that there was only a very small difference between the performance of students in British Columbia and that of 17 year olds in the United States National Assessment of Science, 1972-73.

The panel reviewed the findings of the contract team and in regard to the concern expressed for the achievement at the end of secondary grades, it suggests that it is hazardous to attempt to make a direct comparison of the Grade 12 performance with that of students in Grades 4 and 8 for the reason that a number of items in the science 12 test are not considered to be valid measures of the current instructional program in secondary schools.

RECOMMENDATIONS OF THE INTERPRETATION PANEL

1. The panel suggests that there is at present too great an emphasis on the process of science and it recommends that a greater emphasis be placed on practical applications and the acquisition of scientific knowledge.

2. The panel suggests that continuing attempts be made in the junior secondary grades to have students approach a mastery level of understanding the basic concepts in science. The panel considers that at this level streaming should be discouraged.

3. In regard to the first recommendation of the contract team (see Summary Report, page 44), the panel endorses the suggestion that a curriculum revision committee revise the junior secondary program and suggests that the shift be away from a primary focus on "process".

4. The panel endorses recommendation 4 (see Summary Report, page 45) that teachers widen their repertoire of methods of teaching science at the junior secondary level and that they allocate some of the time spent on routine marking of laboratory reports to the planning of difference approaches.

5. The panel suggests a minor modification in recommendation 7: that school districts investigate the sizes of their junior secondary science classes and consider reducing large classes to levels compatible with safety and "the best learning conditions for students".

6. Similarly, a modification in recommendation 8 is supported, viz., that school districts designate selected personnel to be secondary science "consultants".

7. The panel does not endorse recommendation 16 (see Summary Report, page 47). It does not agree that there is a need for any more general science courses. Sufficient alternatives are already available; e.g. Technology 11, Earth Science 11, Human Biology 11, Agriculture 11, Horticulture 11.

8. In regard to recommendation 17 (see Summary Report, page 47), the panel suggests instead that school districts should ensure that the recommended time allotments (120 hours per course) be followed in secondary science courses.

9. The panel supports recommendation 18, "That teachers of science at both the junior and senior secondary levels make a conscious effort to promote the development of skills such as designing experiments and interpreting data, the ability to discuss intelligently the current issues related to science, and an appreciation of the nature and methods of science".

10. The background data sought in provincial assessments should include information about each student's facility in English.

11. The performance of students should be considered in the light of the limited experience that they have had with multiple choice tests.

12. Continued efforts must be made by the Ministry of Education to review the present science curriculum guides, materials and texts to provide the best possible learning resources for B.C. students.

APPENDIX D

CURRICULUM REFERENCE CHART (SECONDARY)

CURRICULUM REFERENCE CHART (SECONDARY)*

During the five years of secondary school, it is expected that all students will complete the following courses. In order to qualify for a graduation certificate each student will have to successfully complete fourteen courses numbered 11 or 12 including:

a) English 11, 12; Social Studies 11; Physical and Health Education and Guidance 11.

b) a minimum of ten additional courses including a minimum of three which must be numbered 12 and a maximum of two (11 or 12) which may be locally developed.

Recommended time allotments during the five-year period	Subjects and Course Numbers					
600 hours	English	8	9	10	11	12
480 hours	Social Studies	8	9	10	11	
480 hours	Physical and Health Education and Guidance	8	9	10	11	
360 hours	Mathematics	8	9	10		
360 hours	Science	8	9	10		
120 hours	French (see Note 6)	8				
120 hours	Industrial Education and/or Home Economics	8				
120 hours	Music and/or Art and/or Drama	8				
240 hours	Two courses numbered '12' selected from courses listed on the curriculum chart					12 12
120 hours	One course numbered '12' selected from Fine Arts or Agriculture or Business Education or Home Economics or Industrial Education .. Marketable Skill Foundation (See Note 9a)					12
1,560 hours (120 for 13 courses)	Elective courses selected from courses listed on the curriculum chart (See Notes 7 and 9b)	0		Total of 6	Total of 7	

*From Administrative Handbook for Elementary and Secondary Schools (Ministry of Education) - Draft, January, 1979, p. 60.

APPENDIX E

TEACHERS' PRIORITIES FOR CHANGE

TEACHERS' PRIORITIES FOR CHANGE*

The junior secondary teachers thought the following changes would improve the quality of science instruction and learning in their classrooms:

- provision of wider selection of printed materials (texts) (86%)
- smaller class size (84%)
- more time for preparation and marking (83%)
- increased provision of in-service (73%)
- fewer classes to teach (71%)
- increased availability of equipment and materials (67%)
- complete revision of junior high program (65%)
- more science books in the library (59%)
- better quality of equipment (58%)
- more university courses in science taken by the teacher (56%)
- fewer subjects/levels to teach (54%)
- more time allocated to science (53%)

The senior secondary teachers thought the following changes would likely improve the quality of science instruction and learning in their classrooms:

- more time for preparation and marking (77%)
- provision of a wider selection of printed materials (texts) (72%)
- fewer classes to teach (69%)
- more time allocated to science (67%)
- smaller class size (62%)
- better quality of equipment (58%)
- more university courses in science taken by the teacher (56%)
- more science books in the library (56%)

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*From 1978 British Columbia Science Assessment Summary Report (Ministry of Education), p. 42.